development. *Pagurus, Galathæa,* and *Hyas* come out in a less developed state, since at the time of quitting the egg they do not even possess a trace of legs or branchiæ. *Astacus marinus,* on the contrary, and *Astacus fluviatilis* are at that time already provided with all the legs and branchiæ belonging to their organization. Other parts with which all Decapods appear to be then already furnished are in some at that time only slightly, in others, on the contrary, exceedingly far developed with respect to size. This relates especially to the antennæ. On the other hand, some possess in the commencement parts which are subsequently entirely lost; as, for instance, in *Astacus marinus* appendages on the legs for swimming, and in *Hyas Araneus* a considerably long spine on the upper side of its dorsal shield, while in other Decapods such parts never occur. Or, in some, parts vanish, which in others are permanent, as the snout in the *Paguri,* and the lateral laminæ of the fan in *Hyas*; and other parts again undergo such considerable changes in their form, that it becomes quite different, as, for instance, central lamina of the fan, the foot-jaws, and the antennæ of several species. One of the most remarkable phænomena is, however, this;—that in Decapods which inhabit the sea the members they employ for locomotion are in the commencement so organized that they can solely or principally be used for swimming (as appears to be the case with the Lobster); in the freshwater Crab, on the other hand, when it leaves the egg those apparatus have such a structure that they can only be employed for walking.

In conclusion, I would still direct attention to the circumstance, that although several Decapods, perhaps even the greater number of them, have in the commencement with respect to the form of their members great similarity with the Schizopoda, and especially with species of *Mysis,* yet the development of the two tribes of animals is very different in several other respects.

XXXI.—*Report of the Results of Researches in Physiological Botany made in the year* 1839. By F. J. Meyen, M.D., Professor of Botany in the University of Berlin.

[Continued from p. 144.]

From C. Sprengel, the writer on Rural Œconomy, we have received a work on Manures*, which is not only of high *prac-*

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tical value, but also contains additions to our science. In the introduction we first obtain a view of the theory which was followed by the author in the compilation of his work. Under *manure*, he understands everything which belongs either to the means of nourishment of plants or to their chemical composition. Besides carbon, oxygen, and hydrogen, the author mentions eleven others, viz. lime, magnesia, soda, potash, alumina, silicic acid, iron, manganese, chlorine, phosphoric acid, and sulphuric acid, which are also to be considered as manures, because they are found more or less in all plants; and indeed, says the author, "they are really manures; for if we strew a boggy or marshy soil with quartz sand, we soon see that plants, particularly grasses, grow better there! The manures are divided into such as merely nourish and strengthen the plants, as gypsum, salt, copperas ($\dot{Fe}\,\dddot{S}$), &c., and such as not only nourish but also act as solvents on several of the constituents of the soil, which are thereby converted into substances suitable for the nourishment of the plants; and to this group are reckoned dung, ashes, marl, &c. The generally received opinion, that minerals, as gypsum, nitre, copperas, &c. act as stimulants on the growth of plants, is considered by the author to be perfectly incorrect; as proof, he mentions that the completely putrified urine of horned cattle consists solely of mineral substances, dissolved in from 90 to 92 per cent. water, and that this is nevertheless one of the most excellent manures. Moreover, the manuring with saltpetre is adduced by the author, as a proof that mineral substances are to be considered as true manures, of which often only minute quantities are necessary in order to promote to an extraordinary degree the growth of plants. The author has here adduced two examples, which certainly appear very striking; but he has forgotten to add that the carbonate of ammonia in the urine is a substance which is completely decomposed in the interior of plants, and that its constituent elements belong to the principal components, or rather to the most excellent kinds of food of plants, and by this the principal argument which he brings forward in support of his theory is done away with. As far as concerns the manuring with nitre, it appears to me as if we were still in perfect darkness as to the explanation of the phænomenon, and that this cannot, at any rate, be used as a *proof* in favour of the author's theory. We know indeed that nitre may be contained in plants, but we do not know either how much of the nitre taken up from the soil is decomposed into its elements, or how much remains undecomposed; the acid of the nitre is probably again resolved into its elements, as in the *tical* value, but also contains additions to our science. In the introduction we first obtain a view of the theory which was followed by the author in the compilation of his work. Under *manure,* he understands everything which belongs either to the means of nourishment of plants or to their chemical composition. 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case of ammonia, and hence it is quite comprehensible why nitre mixed with the soil in proper quantities is so highly advantageous. The idea of the most celebrated chemists, that most vegetable substances require only carbon, hydrogen, and oxygen to their formation, and that beside these nitrogen is only necessary for some certain classes of bodies, is held by the author to be erroneous; for he assumes that gluten, legumin, &c. contain lime, phosphoric acid, sulphur, &c., besides their usual ultimate constituents, and that these substances (gluten, &c.) cannot make their appearance in the plants unless the above-mentioned inorganic bodies are combined with them. Sprengel assumes also, that the woody fibres are the skeleton of the plant, and consist of $\dddot{Si}$, $\dot{Ca}$, $\dddot{Al}$, Fe, Mn, C, H, O, &c.; the chemists' idea that the fibres consist of the three last-mentioned bodies alone, is in his opinion quite false; for, says he, if one burns the purest possible fibres, there always remains a small residue of ashes consisting of the above-mentioned substances. It is a pity that the author has not stated more plainly what he means by "fibres;" vegetable anatomy teaches us the infinitely great variety in the physical properties of the membranes which form the cells, and he who has attentively followed with the microscope the formation of the deposits of new membranes, will plainly see that all those inorganic matters, or a great part of them, which are contained in solution in the sap, out of which the formation of the membranes proceeds, must exist either in the substance of the hardened membrane or in fine layers between the strata. Here, probably, are all the inorganic substances which accidentally enter into the sap, in larger or smaller quantity. The small quantity of ashes found in starch can only be explained in this manner. Perhaps, therefore, the author is in error when he compares the appearance of the above-mentioned matters in the cellular membrane of plants, with the deposition of phosphate of lime in the bones of animals, and I have already (in the former Reports) drawn attention to the insurmountable difficulties in the way of the experiment, or of a perfect purification of the cells.

The author considers dung, it is true, as the universal manure, but says, that sometimes even this is not sufficient, because it contains too little mineral matter. According to his ideas, therefore, the plants in such cases were in want of the true mineral manures, while, as is well known, this phænomenon is explained by others in a totally different manner.

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The author also states very positively that the soil can then only produce good crops, when it is provided with the neces-

sary substances; it will always be the better if all that which it produced is left to it, for it is then manured not only by the vegetable matter produced, but also by the substances contained in the atmosphere, which mix with it in the form of dust dissolved as it were in the rain. After the introduction, the author treats largely of the external and internal structure of plants, or of the organs by which they exert their functions and procure nourishment, but this section must be designated as altogether unsatisfactory, which, however, has no further influence on the practical value of the work; it would, however, have been better if this part had also agreed with the present state of the science, for Vegetable Physiology has advanced so much in the last ten years, that it might have been presented in such a form as to have appeared both interesting and instructive, even to the practical agriculturist. The author has formed this section principally from the old (1827—1830) writings of DeCandolle, and now teaches some points which certainly DeCandolle himself has long since acknowledged to be erroneous; for instance, the root-spongioles, the ascent of sap in the intercellular passages, the excretions of the extremities of roots, by which plants are said to prepare their food, to kill others, &c. &c. The new experiments (former Report, p. 2) which have been instituted to ascertain the origin of nitrogen in plants, are looked upon by Sprengel as quite conclusive, and he correctly remarks, that we can never hope to obtain a clear idea of the nutrition of plants, unless we call in the asistance of chemistry. The author observed, that plants growing on a soil containing much chloride of sodium, evolved, beside oxygen, also much chlorine, which seems to me to prove that the nitrates also are decomposed when in the plants, and that the manuring properties of such substances may be explained in this manner, as has been already stated. To the functions of the leaves Sprengel reckons the following:—that they draw off from the other parts of the plants, particularly the young shoots, branches, and stem, the excess of fixed matters, on which account they often contain ten times as much of these bodies as other parts; however, this phænomenon has been explained by later physiologists in quite a different manner; moreover, there are a great number of plants in which the bark of the stem contains most mineral matters.

In another section Sprengel attempts to prove that a certain quantity of mineral matter is necessary for the growth of plants; the physiologists do not doubt this, but they explain it differently. The reason why bulbs which are grown in water do not last two years, is, according to the author, because the first time they are deprived of so much mineral

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matter, that the quantity necessary for their second budding is wanting. The physiologists have until now explained this well-known phænomenon quite differently, and had the author examined accurately with the microscope such bulbs as have once flowered, he would have noticed in them a great loss of starch and gum, and in their stead a large quantity of crystals. Indeed the growth of many plants which hang in the free air, e. g. the *Ærideæ, Sedum Telephium*, &c., is said according to the author's view to be caused by mineral substances, which are deposited on the leaves as dust, partly dissolved by means of carbonic acid in the moisture of the room, and are then absorbed by the leaves. But here it is not difficult to see that he applies everything to defend his hypothesis, which goes through the whole of this, in other respects, valuable work; indeed, in some cases, where it is not at all necessary, e. g. in the last-mentioned; for we know already for certain, that such plants as grow in the air or in distilled water, consume their own reserves of nourishment, which are often very considerable.

We consider also not only as a perfectly improved hypothesis, that which the author says concerning the formation of organic bodies in plants, but we believe that in the present state of Vegetable Chemistry we dare not propose such views. Plants, namely, are said to form their organic bodies out of the inorganic matters which they receive from the soil or the atmosphere by the assistance of light, heat, electricity and water, in a manner which remains to us for ever incomprehensible. Such general doctrines as, "Plants organize inorganic matters, and animals vitalize the already organized vegetable matters," are indeed very attractive, but, as I believe, perfectly undemonstrated. Physiology teaches us that plants absorb all substances which are offered to them in a sufficiently fluid state, and if these substances act as poisons the plants die; but the author inculcates in this respect the following, quite improved, doctrine. Minerals, as lead, arsenic, copper, selenium, &c., are without exception hurtful to plants, they injure however one more and the other less; which is explicable by the fact, that the one plant more than the other, has the power of rejecting matters not belonging to its chemical composition, or if it has already taken them up, of ejecting them again, and this excretion takes place not only by means of the roots but also by means of the leaves, and these latter die partly thereby generally at the extremities. As an example to prove the latter statement very clearly, Sprengel states, that when a plant of barley a foot high is watered with a small quantity of a solution of a lead or copper salt, the

matter, that the quantity necessary for their second budding is wanting. The physiologists have until now explained this well-known phænomenon quite differently, and had the author examined accurately with the microscope such bulbs as have once flowered, he would have noticed in them a great loss of starch and gum, and in their stead a large quantity of crystals. Indeed the growth of many plants which hang in the free air, e. g. the *Ærideæ, Sedum Telephium,* &c., is said according to the author's view to be caused by mineral substances, which are deposited on the leaves as dust, partly dissolved by means of carbonic acid in the moisture of the room, and are then absorbed by the leaves. But here it is not difficult to see that he applies everything to defend his hypothesis, which goes through the whole of this, in other respects, valuable work; indeed, in some cases, where it is not at all necessary, e. g. in the last-mentioned; for we know already for certain, that such plants as grow in the air or in distilled water, consume their own reserves of nourishment, which are often very considerable.

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whole plant lives but several leaves die. This fact is certainly quite true, but we must explain it otherwise. If only a small quantity of a poison in a dissolved state is offered to a plant, and this poison is not one of the very strongest, like hydrocyanic acid, it is carried up (like all other dissolved substances) with the water through the stem into the leaves, where the process of digestion takes place; here, therefore, the poison collects and kills, but the whole plant does not die from its effects, because the quantity was too small to poison the large number of cells with their contained sap.

The practical part of the work begins, properly speaking, at page 80, and this section treats most circumstantially of all the different substances which have been recommended for manuring the soil, and, indeed, as fully as any agriculturist can wish; hundreds of analyses of the manures accompany the doctrines which the author brings forward concerning their application. This is clearly not the place to give a special account of what service has been done in this purely practical part of the work; we will only mention here observations and theories with which the author makes us acquainted in order to explain the action of this or that kind of manure, because this is in close connection with the study of the nutrition of plants.

It appears, from all observations, that food in the bodies of animals is not enriched with, but rather exhausted of matters fit for manuring, because the nourishing parts are extracted and retained by the animals; if however we see sometimes that animal excrements produced from a certain quantity of food, manure more powerfully than the food itself, it is only to be explained either by the quantity of mineral substances which are mixed with excrement, or we deceive ourselves in as much as the dung acts powerfully at first but does not exert this action for a long time, while the food manures at first feebly but afterwards lastingly. The dung of animals will, however, always be the worse, the poorer their food is, and in proportion as it is better digested and extracted by the animal. In speaking of the animal manures, the author always draws attention to the development of carbonate of ammonia, which is a substance so exceedingly nutritive for plants, and states that in the treatment of the dung the principal object to be held in view is to retain that ammonia, which may be done by solution in water, or still better by combining it with humic acid, which is contained in sufficient quantity in mould. With regard to the celebrated manuring with bones which has been tried with such great success in England, the author says he has convinced himself that nothing but

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the bone earth (phosphate of lime $\dot{\mathrm{C}}\mathrm{a}^{8}\ \dddot{\mathrm{F}}^{3}$) is the manure, and that this substance only does good in such a soil as is poor in it, which is said not to be the case in Mecklenburg and northern Germany, on which account no such astonishing success has been seen to result from manuring with bones. On the contrary, the English soil is said to have been exhausted of its phosphate of lime by the repeated cultivation of wheat, so that in it this manure is very successful. We have shown in the commencement the views which the author takes of the action of mineral substances as manures, and, according to it, the action of several, as lime, marl, gypsum, &c., are explained; if these substances are not present, or are in only small quantities in the soil, then they must be added, and in order to ascertain this it is absolutely necessary to examine the soil chemically. If one wishes to manure with marl, both the marl and the soil must be first examined, for marls are very variable in their composition, and it is not every one of them which will suit one particular soil.

From M. Pabst we have received another very important work on Agricultural Œconomy*, which treats of the cultivation of plants agriculturally, but it is quite practical. He who wishes for any information concerning the cultivation of those domestic plants which can be produced in our country, will find in this work sufficient instruction.

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XXXII.—*A Synopsis of the Genera and Species of the Class* Hypostoma (Asterias, *Linnæus*). By John Edward Gray, Esq., F.R.S., Keeper of the Zoological Collection in the British Museum.

[Continued from p. 184.]

Fam. 3. Pentacerotidæ, *Gray, Syn. Brit. Mus.*

The body supported by roundish or elongated pieces, covered with a smooth or granular skin, pierced with minute pores between the tubercles.

A. Pentacerotina. *Body pentagonal or suborbicular, rays short, dorsal wart single, the ambulacra edged with a series of small spines divided into rounded groups.*

a. *The ambulacra with a single series of large spines near the edge.*

* *Body suborbicular, convex above and below; covered above and below with granules, and scattered conical tubercles.*

* Lehrbuch der Landwirthschaft. Zweiten Bandes. 1^{e} Abtheilung Specielle Productionslehre. Darmstadt, 1839.

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